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Pilot preserving machine's balance with his weight on one wing. A bad landing; high and dry at low tide. A group of instructors; hale and hearty men, all.

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THE NERVOUS ELEMENT IN AVIATION.

By G. U. PILLMORE, Lieutenant, Medical Corps, United States Navy.

Most of the discussions concerning aviation in the medical journals have been of a very special nature. The exhaustive researches and experimental work completed by the eye and ear specialists have placed this branch of medicine in an important position. The importance of the eye and ear specialist's examination of the applicant for aviation is unquestioned. To their most thorough and diligent application we owe the present high physical standards in naval aviation. Their work has become so prominent and their study of the ear apparatus, for example, has become so thoroughly recognized that when one speaks of the medical aspect of aviation the civilian physician at once thinks of the Bárány whirling chair, and his mind turns to the eye and ear specialist.

We had at the station at Bay Shore, Long Island, about 14,000 hours of actual flying time in the air and I investigated about 100 crashes. I watched the daily routine work with deep interest. I associated as closely as possible with these young fliers and tried to understand their likes, their dislikes, and their whims. I listened to their many tales of experiences and difficulties in the air and myself experienced many of these things with them. Now I can say firmly, that the best flier is the one with the best head and the most common sense, with good judgment, and a clear, healthy intellect which he keeps that way.

As a result of my experience I believe that the importance of eye and ear tests has not diminished but that the principal place for their consideration is the recruiting station. Once a recruit is passed to the aviation training station as normal another phase of his medical recruiting begins and here the nerve specialist, using that term in its most general sense, becomes the most important examiner. Not only must functional changes in the nervous system itself be closely watched and studied but also the more subtle changes and vagaries, which frequently arise during the student's training and show themselves as emotional disturbances, should be observed.

My first case having a definite relation to this aspect of aviation was a student flier sent to me by the officer on the beach in charge of

flying. The young man reported to me alone, and said that he had been sent to me by the flight officer for an examination. I concluded that I would phone to the flight officer for information, and soon I heard a voice saying, "Doctor, I have taken that boy whom I have just sent over to you up for a flight three times to-day, and every time I pushed the plane over the 'hump' that young fool has frozen on to the controls. The last time up he hung on so tight that both of us nearly went to Davy Jones's locker. If you want my honest opinion about the case, I will say that the fool is about scared to death. Let me know what you find, will you?"

I must confess that the information set me back a bit for a moment. But I kept the young fellow at the sick bay for nearly a half day making examinations of his eye and the ear. My report at the conclusion of the long examination was that the man, as far as I could see, was in fair physical condition. A careful questioning of the individual and a complete history of the case, however, revealed a man in a stage of nervous exhaustion, with a distinctly neurasthenic history. So I talked with the flight officer and told him all I could about the boy's nervous condition. I gained the flight officer's confidence at once, and after that he sent me every man who showed anything affecting his flying no matter what it was.

There were two classes of men to be constantly watched. First were the instructors who had been flying for a long time and were the teachers on the station. The second group included the students who were still learning how to fly. The problem was comparatively simple with the instructors, for they were permanent officers of the personnel of the station and I was in constant association with them over a period of many months. With the students, however, the problem was more difficult, for as soon as they were qualified to fly they were sent south for more advanced flying and patrol instruction at another station.

The course of instruction was essentially preliminary. It was here that we met the man who had his first trip in an aeroplane. In fact it was exceptional at Bay Shore to find an individual who had ever been in an aeroplane before. Two or three had had flights in some of the old types of the Curtiss plane.

Of course, students were coming and going as fast as the exigencies of the training school would permit. The average length of time existing between the attachment and detachment of the student at the station was a little below 40 days. All the information gathered about a man had to be collected within that length of time. As far as possible they were placed in classes in so far as my department was concerned. There were the good fliers, the poor fliers, and,

of course, all kinds of curious intermixtures of freak fliers and inconsistent ones up and down the scale.

The different cases investigated with relation to aptitude for flying were handled individually and were taken up as though the whole matter were an extremely personal affair. The failures were not advertised to the camp except in the case of a man who simply flunked out and could or would not fly, whereupon he was given the choice of reverting to the status of an enlisted man, or of leaving the naval service altogether as most of the total failures preferred. The disgrace attached to the latter occurrence affected the man very much as a rule, although several did not seem to mind such drastic measures, for their main desire was to get away from the sight of an aeroplane.

The individual after having once enlisted for actual duty involving the flying of heavier-than-air craft, and having successfully passed the final examination in the ground-school course, simply had to make good. The majority did make good and received their flying commission with the whole-hearted enthusiasm born of having enjoyed the entire course of instruction. A few completed the course and were successful because of plain grit and determination and a much less number could not make the goal at all. The latter group, practically always, did not like flying and made such failures in attempts at it that they were excluded. Several in this latter group however did like it but could not master the art of flying at all. These generally made the doctor's life miserable by crashing up machines and getting into all kinds of wrecks one after the other. But they made good ground officers in aviation and were generally commissioned as such.

The instructors at the training station were selected and assigned to the various training stations with care. Supposedly, they were the best fliers the Navy could produce, and were recommended for this kind of duty. There was very little changing about of instructors from one station to another. So month after month they went through the daily grind of teaching men to fly. Their students went across and did valuable patrol duty on the high seas, and as word came back of their excellent work over there, occasionally there would be outbursts of grumbling over the hard luck of being forced to stay in this country for training duty. But, of course, every one could not go, and duty was duty.

In considering the important work of an aviator, we become impressed with the fact that, to be successful, he must conform to a good mental and physical standard. Our physical standards are well established and in examining candidates for aviation we follow certain rules regularly. However, in regard to the mental state,

which is of great importance, there is not at this time any fixed standard of examination.

What is needed most in a flier is a high degree of mental efficiency with no departures from the normal manner of thinking, acting, and feeling. We can not imagine a good flier having a functional neurosis such as psychasthenia, showing states of pathologic fear or anxiety with tics present and feelings of inadequacy, influencing his make-up.

There are certain individuals with whom we come into casual contact daily who are not of the normal make-up, but who are not classed as having abnormal mentality. Such individuals often present an appearance of brilliancy and originality, but with this betray, as a rule, defects of judgment, their plans often resulting in failure. They do not remain at one occupation long enough to obtain a thorough knowledge of it and are forever changing from one manner of life to another. They lack the persistence or will power to complete or carry to a logical conclusion any undertaking. Slight obstacles will discourage them and often lead to radical alterations of their mode of life. They manifest but little sympathy or consideration for others. They are self-absorbed, vain, egotistical, and self-assertive. An individual of this type often impresses his friends or relatives as a kind of genius. Time passes, however, and no results are achieved. The money of this or that relative is lost in various enterprises. He lies and swindles to obtain money. He neglects his family. The true condition is only disclosed by a painstaking study of his history. Quite commonly the family will scout the idea of the young fellow not being mentally well, particularly where a rich father, long-suffering and indulgent, is concerned.

Again, an individual may inherit a tendency to nervous exhaustion. His resistance to fatigue may be very feeble. By the demands that aviation make on him, overfatigue is frequent. If he has inherited neuropathic tendencies he may be reduced to such a state that the rest or food required to restore a normal individual can not place him upon a normal base again. In time he develops a well-defined neurosis with definite symptoms. There will be a marked diminution of his capacity for sustained mental effort. He becomes chronically tired. He puts off matters requiring a decision, and finally with the development of marked uncertainty, hesitation, and habitual indecision the instructor pulls him out of flying and sends him to the doctor for examination. We will often discover cases which appear to be decidedly non-neuropathic but still experience nervous exhaustion. However, the individual does not develop a distinct psychosis.

Fully as important as the psychoses of neurasthenia are the motor, sensory, and general somatic disturbances.

We find some men whose muscles reveal fatigue and the subject appears to have become suddenly weak. The statements of the student in regard to motor symptoms are evident. He will declare that the drilling on the parade ground seems to be the last straw on the camel's back. He thinks that if he can get out of drilling he will be all right. An examination of his tendon reflexes may reveal a diminution of the same. Commonly, however, the reactions are exaggerated. A very fine tremor of the hands may be found. Placing the man on very light duty does not improve him much. We know that it is not on account of lack of rest, for he has very little liberty and goes to bed early and sleeps the sleep of exhaustion. In the morning, however, instead of feeling rested, he still retains a tired feeling.

Again, various reports at the sick bay show many mild sensory disturbances. The individual complains of obscure pains which refer to the limbs, trunk, or head. I remember one lad in particular who said that he felt as if the whole top of his head had been scooped out and a vacant space remained from just above his ears upward. A superficial examination showed stigmata of a degenerated nervous system. Complaints of dizziness are not often made. They should lead one to think of neurasthenia and not into examining the ear alone. Insomnia is very frequent, and a student will hear the constant roar of the motor for hours after going to bed. He tosses about and has difficulty in procuring rest.

A common symptom relates to the digestive tract. The individual at first feels no distress after taking food, but later he feels oppression with a sense of weight. As a result of the extremely high nervous output required, the excess stimulation of the innervation of his stomach will cause a hyperacidity.

As we look over the circulatory apparatus of these individuals who represent the neurasthenic types with an insufficient number of nervous impulses delivered throughout the body, the results of this deficient innervation become evident. We find cold extremities, for example. In marked cases, which are not common, the force and rhythm of the heart's action is not steady.

The psychic phenomena bear a definite relation to the circulatory phenomena as, for example, in fear, where the individual's pulse suddenly quickens and even palpitation of the heart may occur. But as regards aviation, transitory palpitation may affect the strongest as death stares him in the face with the machine and pilot in a precarious predicament. I have had palpitation of the heart as I watched a plane come tumbling into the water from a height of 4,000 feet.

Another physical condition noticed in the two weak-nerved individuals of this type was a sexual disturbance. Of course, the strain of flying does not bring the neurasthenic to the stage of the special

phobias and marked obsessions. We get rid of him long before he completely breaks down, and I suppose upon going back to civil life he regains his normal status again.

The psychology of flying covers a vast field which an ordinary observer will find extremely difficult to traverse. In the study of the mind and mental operations of an aviator we find ourselves ranging in our observations between two positions. The first is occupied by the flier who flies along with practically no thought of danger, or, if it is present, it is such a part of his subconscious mind that he does not experience any sense of it at all. The second is occupied by the young fellow who, upon first going up and experiencing an unpleasant thrill with his pilot, immediately grabs hold of the controls and hangs on for dear life. The latter case represents a confusion of mentality both quantitative and qualitative. It is between these two positions that the doctor often has to work as a psychologist.

There are a few conditions which it would be well to note as specific contraindications to flying. For example, there should be no history of attacks of malaria. Cold in high-altitude flights might precipitate a chill.

Every man in the Flying Corps of the Navy must have a Wassermann done upon entrance. I think it would be a good thing to have the Wassermann taken every six months. Mental symptoms in the primary stage are, of course, infrequent; however, we may meet with dizziness, insomnia, headache, and depression. The psychic shock of the discovery of having contracted this disease might play some rôle.

A man with a mild beginning of pellagra could easily escape the attention of the recruiting office, especially in the North, where we see very little of it.

In alcoholism there is a depression of functions—a confused and poor mentality—if the indulgence has been carried far enough. The young man who is subject to alcoholic debauches will break down eventually in flying. One man was discovered on the verge of delirium tremens. He was an instructor who is not flying now. The degree of resistance to alcohol in some individuals may be enormous or exceedingly slight, so it is a fixed necessity that it be cut out entirely.

Any form of drug habit, disorders of metabolism, such as diabetes or gout and a vast category of visceral diseases, should exclude the individual from flying. Under visceral diseases, and particularly Bright's disease, we find any number of conditions that would contraindicate flying. Hence the value of giving fliers routine physical examinations.

Other diseases which have a definite relation to mentality in flying are diseases of the ductless glands, epilepsy, hysteria, cerebral

syphilis, multiple cerebro-spinal sclerosis, arteriosclerosis, and any pathological condition of the brain.

The English observers lay particular stress upon the medical history. They believe that a more complete medical history of the applicant should be taken along with the physical examination. This should cover inquiry into previous occupations, habits (especially as to alcohol and tobacco), and mode of life as well as previous health and family history.

The family history, especially with regard to diseases of the nervous system, might shed some light on the type of soil with which one has to deal, especially in relation to the strain of war flying. A candidate with a history of easily induced chilblains should not be allowed to fly at great heights. Inquiry should be made into the usual amount of sleep obtained, and whether this is disturbed or not. Any signs of restlessness should be noted as they might point to an unstable nervous system.

It is believed that the psychological examination is of equal value to the physical examination in the profession of flying in heavier-than-air craft.

The best examination that can be given to a prospective student for aviation is one given by a doctor having a good knowledge of special aviation tests combined with personal experience in handling the "controls" of a plane of his own. The best method of having such a doctor look over the candidate completely is to order the candidate to a flying station immediately after he has met the preliminary physical requirements; and, once there, to allow the doctor who flies himself to continue the rest of the examination at leisure.

It would not take long for the medical officer to reach a definite conclusion. This would indeed save the needless loss of many weeks to that man who, after going through a school of technology, flunks out later when the real flying begins. Send the man to technology after he has passed the medical officer's examination at a naval air station. If the student then likes the little flying he has seen and experienced with a medical officer, if he is enthusiastic to reach the goal, he will apply himself far more diligently at the technological school; and, furthermore, will have the proper attitude toward aviation, namely the selection of it as a chosen profession.

The student at the present time gets his physical examination first, and is then sent to the ground school of technology for many weeks, after which he is sent to an air station for training, and finally experiences his first flight.

Of course the above can not be accomplished if the medical officer doing duty at an aviation station is detached frequently and placed on medical duties other than aviation. A medical officer should be attached to aviation permanently. Many important and intelligent

observations of extreme value have been spoiled because suddenly after a few months of this duty the medical officer is placed on some other kind of work altogether. I have on my desk several papers written by very intelligent observers all of whom were detached from aviation after a very short time at the flying fields. I am sure that their continuance with the aviation unit would have resulted in very good and exhaustive research. Unfortunately a medical officer new to aviation has to start at the very beginning when it comes to getting experience in actual flying sensations himself. He can not begin where some one else left off.

An editorial written in the *Lancet* of January 12, 1918, presented the idea of a medical department for aviation duty alone. I certainly believe that this should be done so far as is possible. There are many problems that one never dreams of until after one has had certain experiences in the air. As stated in the *Lancet* there is not a medical man with or without special knowledge who can not see that the strain on these young men is great, and that to allow unfit persons to take the responsibility of flying, air scouting, and air fighting may be to condone suicide. Questions of blood pressure, of cardiac affections, of muscular balance, and nervous stability are alike involved, and the flyer should not only be selected from the beginning for his sound physiological and particularly psychological make-up, but he should be submitted to regular scrutiny during the whole time that he continues to discharge his duties.

A medical officer should investigate the causes of injuries in order that accidents may as quickly as possible be grouped according to their similarity in occurrence, or in other points, for in this way the existence of some common physical defect, which has led to a group of accidents, may be detected in other aviators before new tragedies have occurred from the same old cause. It is important that a medical officer should be a member of the board appointed by the commanding officer to investigate the cause of crashes. A medical officer arriving fresh on the station every few months will never help to solve the problems of flying as quickly as the medical officer who flies himself and has been with aviation for a long time.

It is believed also that the medical officer for this detail should be selected with as much care as a student flier. He should be capable of becoming engrossed in air problems and see and experience them in the air himself, for aviators do not as a rule lay particular stress upon telling all their own difficulties and defects in the air, and to ask questions about certain things will very often bring you nowhere. Fliers dissimulate well, if for no other reason than to protect their reputations as good fliers.

Aviation at this date has gone far beyond the experimental stage. Few men make a success in medicine unless they like it, and the same

holds true with aviation. Many young medical students never get beyond the first year in college, and one sight of a leg amputation is enough. One sight of an aeroplane crash or one flight with "stunts" will do up a few of those prospective candidates, who upon applying for aviation hold uppermost in their minds the tender spot some girl had in her heart for the bold aviator who after shutting off the power to his engine, as the newspapers describe it, "places his machine fearlessly into a long glide, and at last lands safely in a level 40-acre lot."

There are undesirables in naval aviation who accomplished their courses during the time the Government was working at high pressure to get fliers abroad. But they are being dispensed with. Many, at last, got in their so-called required number of hours who disliked flying, were afraid of it, and soon wanted to get out. But the thought of being a "flunk" drove them on, and rather than admit that they did not like it would crash any day. This was courage of a kind, indeed, but courage misplaced.

A certain student flier who had a few hours of solo work could not properly describe to me how to get out of a tail spin. He said the problem had not occurred to him before, and he declared that the new sensation of suddenly finding himself really in an aeroplane was so exciting and there were so many things at the air station which he had never heard of before and events were occurring so quickly one after the other that parts of it were a jumble in his head. Luckily for this boy the plane had practically flown by itself, and the air conditions were good at the time.

Major Greene, in *The Military Surgeon*, suggests testing ability to qualify as an aviator by giving the applicant an opportunity to fly as a passenger. He may develop certain symptoms, not discoverable in an ordinary medical examination, which would lead to prompt disqualification. On the other hand, an applicant of doubtful qualities might readily demonstrate peculiar fitness for flying. I have found this to be very true.

The so-called attitude of staleness is observed not infrequently in some of the old fliers. When this is discovered, a most thorough investigation of the man's habits should be carried out. Occasionally too much indulgence in alcohol and the night lights of a great city will bring about a certain listlessness toward flying. A man can lower his physical condition to the point of uselessness by such debauches. He can fly after his excesses, but he is decidedly not at his best. A flier should be trained as an athlete in order to bring out his best ability. Befuddled brains from "hang overs" should never direct an aeroplane.

The ear specialists and the eye specialists have long since established themselves in aviation and, it is believed, have swung the pendulum too far to the side of the eye and ear being the all-important

organs in the profession of flying. It is time that a reaction were brought about and that the neurologist occupied as strong a foothold as do the eye and ear specialists.

It is not out of order at this point to mention a few things a flier must bear in mind as you watch him gracefully playing hide and seek with the clouds way up yonder at a dizzy height. If you know him well and can have the expensive pleasure of flying about with him on some of his capers you will find him to be a very matter-of-fact individual who will wink and chuckle good-naturedly at you after he has scared you nearly to death by looping the loop a half dozen times or dropping into a tail spin.

As said before, the natural accomplishment of flying is the result of the proper following of natural laws. I will describe to you as simply as I can the method of ordinary straight flying and not attempt to discuss the fancy tricks and "stunts" that the young dare-devil performs.

The instruction given to students is not along hard and fast lines that can be studied from a textbook. The instructor does not sit at a desk distributing typewritten circulars on the subject of how to fly. The instruction is carried out while actually flying. Faults and improvements are discussed while on the beach with the pupil, to whom is given all the additional information that the instructor possesses. The pupil is checked up as his defects appear.

The individuality of the instructor affects the method of teaching. For example, one instructor believes that conservative flying is best when a student is on his first flight, and another believes that on the first flight the young fellow should be given real thrills.

STRAIGHTAWAY FLIGHT: A BEE-LINE COURSE.

While flying horizontally all fore-and-aft positions should be carefully maintained. Most attention should at first be given to the direction of the course. Considerable pressure must be applied to the right side of the rudder bar to keep the machine from sliding to the left on account of the torque of the motor. The amount necessary must be determined by watching along the side of the fuselage and adjusting the pressure until the nose of the machine holds an absolutely straight course. The importance of steering an absolutely bee-line course, is due to the fact that the machine has a dished angle. This makes the machine automatically more stable. Thus, when right rudder is applied the shifting of the forces drops the right wing and raises the left wing. The opposite is true. Conversely, if our wing drops owing to unevenness in the air stratum the machine will turn in the direction of the low wing. Hence, the importance of steering a straight course for the rudder serves two purposes, not

only steering the machine, but keeping it level. The instant the nose of the machine moves ever so slightly, to the right or left, the pressure on the opposite side of the rudder must be increased until the swinging is checked. But the pressure must be released and the rudder returned to neutral the instant the nose comes back in line with the course. If pressure is kept on too long, the machine will slide over the course to the other side and, if this is kept up, it will result in a snaky course. The best helmsman is the one who steers the straightest course and moves the wheel the least. The same is true of the pilot of a plane. Watch the nose of the machine like a hawk and stop the instant it starts. If enough attention is paid to this, it will soon become intuitive. Firm pressure should be kept on both sides of the rudder. Eventually the pilot should be able to "feel" the air on his rudder and allow for bumps as they first hit the machine. If the pressure against the right foot increases suddenly it means that the wind is pushing against the right of the rudder. If the rudder holds its place this pressure will swing the machine to the right, as it is the equivalent of right rudder. For this reason if the pilot is wide-awake and eases off on his right rudder until he feels no thrust on his right foot the machine will fool the gust and keep a steadier course. Sometimes this sort of gust is so strong that merely letting off on the right rudder will not suffice and left rudder will be necessary. If the pupil watches an experienced pilot's use of the rudder, he will see that the bar is almost never stationary in disturbed air, but is moving slightly to left and right through a very small arc. This is because the pilot is playing with his rudder to "feel" the air. The sooner this knack is acquired the better for the pupil.

LATERAL BALANCE.

We have seen that lateral balance can, under ordinary circumstances, be maintained by making use of the fact that the rudder bar is operated by the feet and manipulates the rudder on the tail of the machine, turning the plane to right or left, aiding thereby in banking the machine. The rudder is the chief agent in controlling lateral balance in fairly calm air, but in bumpy air the ailerons must sometimes be used. Rudder control of lateral balance is at best slow, and in case of very bad air sometimes insufficient. Aileron control is faster but for this reason less finally controllable. A mixture or coordination of rudder and aileron control is proper and often essential. Neither one will do alone. They will act together much more easily and quickly, as together they have more control surface and this surface is diverted between the three extremities of the machine. Thus if the right wing drops down suddenly, increase the pressure on the left rudder, and at the same time turn the wheel

to the left until the pressure on the plane lets up, when you must instantly restore the control to neutral. You can feel the neutral position of the wheel, for there will be no pressure on the ailerons as they are in a straight line with the wing. The amount you must turn the wheel varies with the severity of the gust, but it is rarely more than a very small amount, and the neutral position will naturally be found, as the wheel is turned off as much as it was turned on to neutral. The importance of correct coordination of rudder and aileron can not be overemphasized. A pilot who does this well can go through any weather with full confidence. There are several means by which you can check your lateral balance. The way you should eventually tell is by feel; that is, use of your sense of balance, but, until you acquire this, certain mechanical checks are necessary. As you steer your course by watching some two points of the nose of the machine, watch that these points do not roll down or up the horizon. At the same time watch your wings out of the corner of your eye and check any rolling that may occur. In machines with Cabaur struts (triangle), use the triangle formed by them for the same purpose. To be sure that you know what level is, look out at the furthest strut on the right wing, see how much of it shows above or below the horizon, and then check the left wing to see that the same amount shows. Here is lateral balancing of the machine as, in your steering, movements should be checked the instant they begin.

LONGITUDINAL POSITION OF PLANE.

This position is regulated and controlled by the forward and backward movement of the wheel. There is no fixed position for the wheel, as this depends on many factors, such as the balance of the machine, the power of the motor, and the kind of flight. There is one cardinal point to be remembered at all times. Disregard of this will immediately place the pilot and machine in a critical situation. The pilot must always bear in mind that the machine must have flying speed at all times. Flying speed is lost in straightaway flight by allowing the nose to ride beyond a certain elevation, or in other words by climbing too steeply. Of course, the angle of flying differs for various types of machines because of the differing power, plane surface, resistance, etc. After some experience, you can determine the critical angle of any machine, but until you acquire this "feel," you must use the experience of your instructor. He will show you the proper flying angle for the type of plane you are flying, but this, of course, is true only when the motor is performing normally. Here again you must use some check of your own guidance until you get the feel. In our training plane, use the point on the nose by which you steer a plane, and note its position on the horizon. This point

must never be raised above the horizon unless by orders of the instructor. This will insure you a conservative flying angle, and is the only correct one for you to use while under dual instruction for the first 15 hours of solo, but often you will have no horizon by which to check up your flight angle until you have acquired feel. There is one invaluable check which you must accustom yourself to use. You can always, except at night, fly so that you can see the plane of the water. This is often all that you can see, so this check makes use of this plane instead of the plane of the horizon, though when the horizon is invisible, the check may be used on either plane, as they are both perpendicular to gravity. As you look out at the wing tips, you will see that the outside struts on either wing cut the horizon or the plane of the earth at an angle dependent on the flying angle of the machine. This angle, by the forward edge of the outside strut and the plane of the horizon or earth's surface, should never exceed 90°. For really conservative flight, it should be nearer 80°. In clear weather with a good horizon, this angle will be checked more easily on the horizon, but in rain, haze, or whenever you can see no horizon, you should fly close enough to the water to check this angle on the plane of the water. As soon as you acquire "feel," you may disregard this check. This particular check is for use only with a motor that is giving its full power. With an under-power motor, the machine's climbing angle will be lowered in proportion to the loss of power. Your lift is obtained by the power given by your motor. If this decreases, you must keep your lift by nosing down and gaining your full speed. You must accustom yourself to the sound of your motor, and train yourself to recognize the slightest peculiarity in its exhaust. If your motor misses or loses vigor, you lose speed, and upon speed solely depends your safety. So keep your speed by utilizing gravity and nosing over until you can feel a good lift. If you lose all your power, you must put the machine in a glide to get flying speed, and keep this until you land. This matter of flying speed is the most important in all flying and is never to be forgotten. Play the game conservatively and always keep speed in reserve. Without speed your machine is as air worthy as a ship with its hull full of holes, because speed is so absolutely essential. Keep this always in mind.

TURNS.

If rudder alone is applied, the machine will skid away from the direction you desire to turn in the same way as does an automobile traveling in a high rate of speed on an unbanked turn. In an aeroplane a skid, if carried out far enough, will result in a complete loss of flying speed. A stall results and flying speed must be regained by a dive in a skid. Flying speed and lift are lost in proportion to

its severity. If bank alone is applied, flying speed and lift will be decreased in proportion to the amount of bank until a stall occurs, when speed must be regained through a dive. A parallel illustration may be seen in the case of an automobile taking a turn banked too much. There are several good illustrations of the theory of a turn, such as the motorcycle in the eggshell track of the circus, a bank motordrome, the chairs suspended from ropes on a pole which are swung around the pole at increasing speed. You should study the theory of the turn until you have absolutely mastered it, for until you understand it, you will never be able to turn well. From a study of the turn, you will see that for one reason there is but one correct bank. There is a straight course with no bank, a most gradual turn with a most gradual bank, and the corresponding increasing bank and radius until you get to the vertical bank and shortest radius.

The actual method of making a turn is as follows: Level your machine to an absolutely horizontal flight. Note some point on nose of machine which is on the horizon. Apply rudder and bank simultaneously, and smoothly, not too fast. Machine will start turning and banking at same time. Keep your points all steady on horizon, note your bank, and when you have reached the desired degree, neutralize your ailerons and keep enough pressure on rudder to make nose of machine travel steadily around on horizon. Adjust pressure on rudder to suit bank, not vice versa. Watch nose, not wing. Occasional glances at wing if necessary are permissible, but you should be able to judge bank by angle of nose of machine relative to horizon. Too much rudder will make you skid, and you will feel air on your outside cheek and also a tendency to lean in toward the center. Too little rudder will cause side-slip. You will feel first a tendency to lean outwards, and when slipping, a strong pressure of air on your inside cheek. In a correct turn you should feel comfortable in your seat with air on neither cheek and should end your turn, no matter how long, with the same amount of bank as you commenced with. Fully as important as the bank and radius of a turn is the elevation of the nose of the machine. The nose must be kept on the horizon, and altitude must neither be gained nor lost. You must guard against the tendency of the "torque" to raise your nose on a right turn, and pull it down on left turn. If you climb on a turn, you will gradually lose lift and stall, and you will then go into a spin. If you gradually lose altitude on a turn, you will eventually spin. In bumpy weather, use of ailerons may be necessary while turning, in order to keep bank constant, but this comes naturally.

To come out of the turn, give opposite rudder and aileron until machine is level horizontally and the desired course is assumed, being

careful to keep the nose still level. Neutralize control instantly this is attained, and check up to see that wings are level and course is true. Fly level for a few seconds before resuming climbing flight. If bank and rudder are not taken off together, the machine will skid. Coming out of a turn well is as essential as going into one. You should practice coming out of turns onto a given course so as to gain accuracy, and you should practice turning through 360° . When you feel that your turns are falling, turn steadily to 720° and the fault will be exaggerated so that you can discover where it lies. Remember your flying speed in a turn as everywhere else, and remember that as you tend to decrease your lift rapidly in a faulty turn with a bad engine, you should be well on the side of excess flying speed. It is very advisable to adopt your own standard turns; that is, one that you can always be absolutely sure of. It may often come in handy. Never bank steeply close to the water, except in case of emergency. Play it safe, for you never know at what instant your motor may quit, and when it quits in a turn, you want room and plenty of it. Except, when unavoidable, no turn should be made under 300 feet.

GLIDING.

The machine glides when it utilizes the force of gravity instead of its motor to maintain flying speed. The machine is under fully as good control in a proper glide as in motor flight, and the old notion that when an engine stops in the air the pilot is doomed has of course been exploded. The pilot's life is in danger if, when his motor quits, he does not instantly maintain flying speed by gliding. Lift is attained by the thrust of the air and the wings, and if the motor can not give you this speed, the glide will. There are all degrees of glides from the minimum when the lift is least, to the maximum or nose dive, when the machine accelerates so quickly as to be of no value near the ground. The proper gliding angle is that which gives the machine a constant speed slightly in excess of that of motor flight. You can determine the speed of the machine in a glide in two ways—first and best, by the whistle of your wires; second, by the air speed indicator. The former is better by far for it is always reliable, and no instrument is always reliable. Also the former is available at night, when you may be unable to use your instruments. The pitch of the whistle should remain constant after you once assume your glide and should be clearly audible. The instructor will show you what is the correct pitch, and you should never glide at a lower one. You must accustom yourself to glide by this sound, for it is absolutely essential and is furthermore important in spiraling. The essential fact to remember, as always in all flying, is to maintain plenty of flying speed. There is nothing so much to be

avoided as a flat glide; that is, a glide so flat that your lift is just barely sufficient to keep the machine from falling. It is not safe to approach this point. The more speed you have, the more lift, hence the more control, hence the more safety. Take for instance the two following cases: One pilot glides down for a landing with a glide so flat that he has speed and no more. Suppose he is about to land when another machine comes suddenly and unwarrantedly in his way. To avoid a collision, he either tries to zoom or turns his machine. The instant he does either, he uses all his lift and stalls. Of course he crashes, all because he has no surplus lift. Now, take the second pilot, who comes down in a good glide with plenty of excess speed. When he zooms or turns he has full control over his machine, and enough lift to last him four or five seconds, long enough to avoid a collision and regain his speed by use of the motor. If Vernon Castle had had enough speed, he never would have crashed in zooming another machine. From this it is evident that the steep glide is better than a too flat one, by all means.

RULES OF THE AIR.

1. A machine taking off "or taxiing" has the right of way over a machine in the air.
2. Pass another machine approaching you as you would if you were automobiling. That is right wing to right wing.
3. Overtake another machine as if you were automobiling on his left.
4. Of two machines one above the other, the lower has the right of way.
5. A machine with a dead stick has the right of way.
6. A machine gliding or spiralling, or stunting has the right of way over one flying level.
7. Never trust the other man to do the right thing; he may be asleep.

After thinking over the above, it is not difficult to realize that a man must be on the alert and have an active, cool mind at all times.

The above outline of ordinary flying is rather crude perhaps and not meant to be sufficient knowledge for a man who intends to sit in a plane and begin to fly perfectly at once. One must overcome many difficulties. The finer points of stunt flying and tight places that a flier must get out of in order to save his life and machine, are not dwelt upon here, for in so limited a discussion the subject can not be handled properly.

It takes one some time to get over the feeling that there is a considerable space between yourself and the earth as soon as you have left it, and the realization that ever so little a thing, such as the turn of the wheel, can place you in a position out of which under certain circumstances you can not recover, surely does arouse subconscious thoughts of the Valley of Shadows from which travelers do not return. True, just ordinary motions and sensible thoughts guide your

hands and feet to control the plane, but to the beginner the new sensation really does make his heart pound in his chest.

You at first view the splendid panorama beneath you with wonder and awe, and then, as you thrust out your neck over the side of the plane and gaze at the terribly blank space directly between you and the earth, you naturally try to think of pleasant things to keep up your courage. Your pilot is a comfort. He grins good naturedly at you, and this reassures you pleasantly.

I still have very kind feelings for the pilot who first took me up. He was a student who had had only three or four hours of solo work. I have always admired him for his nerve, for he did not acquaint me with his inexperience until we had reached terra firma after a very bumpy ride.

This ride occurred during the first few days after my assignment to an air station. Of course, my confidence in aeroplanes increased thereafter, and I was not satisfied until I had hold of the controls myself. But it took me some time to get over the feeling of being up so high. I know my head was not cool enough to fly a plane right, although the instructors would tell me carefully just what should be done and I would know how to do it. I suffered from what is called in the hunting districts "buck fever." I have also experienced "buck fever" while hunting. It occurs after you have hunted for a long time without success, and then suddenly a fine buck deer rises in front of you perhaps 75 yards distant. You become so excited that as you aim your rifle you begin to shake all over and must use all your will power to make a steady aim. After you have brought the deer down with your shot you feel weak.

I believe that I had buck fever quite badly during several early flights. My mind was influenced more perhaps by some of the accident cases I picked out of the bay following crashes. During that time one poor lad in particular weighed upon my mind, for he was a friend. I assisted in removing his horribly mangled body from the wreck. He was beyond recognition. But I still kept going up as a passenger, and in time the unpleasant feeling wore off. I can say very frankly, however, that I always have possessed a subconscious feeling of impending danger while in the air. It has not hampered my sense of security, however, and I believe that I am as cool about such matters as the average person.

I lay down these facts merely to show the feelings of the average individual in his attitude toward flying heavier-than-air craft. I do not consider myself overcalm or cool while meeting the exigencies of life, and being convinced that my nerve is about the average I have used the analysis of it as a sort of basis to work out the feelings of men who have made a profession of flying.

I have found that the average number of fliers at first experience about the same sensation I felt myself. Some have more nerve and daredeviltry in them and they are the excellent fliers. They are so cool that it becomes almost a second nature in them to fly. Others are very sensitive and will never get over being afraid. I knew one instructor who, I was sure, hated the sight of an aeroplane, but he would not give up until after the armistice was signed because he did not want to be branded a quitter. Bumpy air scared him so that if he could possibly get out of it he would not fly. His students did not have the proper confidence in him. He was what is known as an inconsistent flier. One day he would fly fairly well and the next he would be porpoising all over the bay and doing other unintentional stunts. He would climb exceptionally slowly and glide down like a shot, as if in a hurry to reach mother earth again, and then away he would go flying just above the water for a much longer distance than was necessary to land, then gradually begin to feel his way down with the back of his pontoon. He talked in a strained manner and was of a neuropathic make-up. But he always turned out his students, and got in the required number of hours. Luck seemed to be with him, for his planes avoided crashes somehow.

Occasionally one finds a beginner who is hopelessly without nerve. Two men that I remember distinctly came to me and on being put through the grill broke down and cried. One lad in particular told me that if the Secretary of the Navy himself should order him out in an aeroplane he would not go. Of course, such cases were thrown out of the service as soon as discovered.

Generally several days of inconsistent flying occurred among the students after a man had been killed by a fall. It is best to not stop the flying because of a fatal accident. It takes some of the weaker ones' nerve down a bit, but brooding over possibilities during inaction is poor policy. With hands and feet on the control, confidence is regained. And this was war and not mere sport.

Students were taken temporarily from flying upon the discovery of very minor defects. For example, the slightest strain or sprain of wrist or ankle would be sufficient to place a man on the sick list. Malingeringers at sick call were uncommon, but when discovered, were watched with extra care. Often they were allowed to carry on for a short time until a thorough personal investigation could be carried out. The investigation would frequently reveal something of significance in regard to the man's flying ability or nerve.

The students, during the early summer of 1918, were often worked too hard. Many of them at that time averaged only five or six hours of sleep. Their duties consisted of more than flying and ground school. They handled lumber, barrels of gasoline, cement mixers, etc., and many were played out and did not maintain the best phys-

ical standards. The system was changed, however, and the hours and amount of work was cut down considerably.

I believe that the nearer we approach the Goshport system of training, the better will be the trained fliers turned out. This system allows a student to fly only when he feels like it, and assigns only two or three men to an instructor. The old system gave 10 or 15 men to an instructor. Under this new system the instructor gets to understand his students better through more constant and personal association, and the students have time to figure out their problems at leisure.

A medical officer's position at a naval air station is somewhat different from that of the medical officer at any other station. The medical officer must know all the men who fly, and know them well. He must be what is known as a good mixer. He must possess the faculty of obtaining the most intimate confidences from these young officers, and must spend hours in informal association with them. He must be liked, and go out of his way to obtain their good will and respect, and be ever ready to sit down, for example, to a lengthy discussion of the young fellow's domestic difficulties.

By so doing you learn your man's make-up. You have an intimate idea of his caliber; so, when difficulties come up in his flying, you have a valuable stock of information to draw upon.

To illustrate the bearing that your possession of his confidence and respect for you may have upon a boy's ability to fly, a simple case of a very young fellow comes to my mind at this moment.

The lad was a very conscientious and gentlemanly young man. He had gone right from home to college and before finishing his course had taken to naval aviation. He was a delicate sort of boy and his intimacy with the hard knocks of the world was not overgreat. I began to notice that he did not eat very much and that he was dejected. He walked by himself a good bit and did not go to bed early. On the beach he seemed to have lost his former "pep." I watched him from a distance for some time and soon began to notice that he was very inconsistent in his flying. His instructor told me also that the boy had evidently lost his "pep." One day the instructor took me up and we followed the boy around the course to watch his flying. At about 10 miles from the station the lad shut off his motor and glided down for a landing, and after taxiing a bit on the water we noticed that his propeller stopped its motion. We flew back to the station and reported his plane as having a "dead stick" and then again flew around the course. As we came back to the location of the boy and his plane the pilot spiraled down and landed a short distance away. I at once noticed that the boy's head was hanging to one side and resting on the fuselage. Thinking that perhaps he was ill, we taxied close in to him and began shout-

ing. He suddenly sat upright and rubbed his eyes in surprise. He had been sound asleep and had not been awakened even by the extraordinary noise of our motor. It took some shouting to awaken him, too.

I requested that the instructor say nothing about my presence to the boy. He had not recognized me in the flying costume. The next day I joined him as he was walking up the street and we had a chat for a half hour as we covered the distance to town. The chat was about nothing in particular. In a couple days, however, he was in my room smoking and telling me the most woeful tale you could imagine about how his girl, to whom he was engaged out West, had just given him the cold shoulder. He said "I am all broken up over it." Of course I had to bolster him up and help him forget it. I obtained three days' leave for him to go to New York, and gave him the names of several people to locate at different clubs. He came back a new man and went to flying like a veteran. The last time I heard of him he had a new girl, had finished his training, and had obtained his commission. He turned out to be an excellent flier.

So I learned that tact and constant association play a great part in discovering the traits essential for making up a good flier. One of course must not go too far with the intimacy. That would not be policy. The medical officer in military branches should not breed too much familiarity. He is a doctor at all times and an officer in grade and rank.

It takes the right kind of medical officer on an air station to help bring out success in flying. He must be on the job, and if he does his work properly, the sick call in the morning is not the all important event of the day. The number of flying hours can be increased markedly through the influence of the medical officer. During the days when the rush was great to turn out fliers, and time lost in getting these men abroad meant a great deal, the doctor had to be on his toes to keep up with the work. Many trips he had to make through the sleeping quarters at midnight to watch them in their sleep and see that they had proper ventilation and sufficient bed clothing and were not disturbed by unnecessary noises. He had to watch them eat, watch them as they returned from liberty, and watch over countless other little things. In short he was one of the athletic trainers, and they all knew that the doctor was working for them, for their health and welfare. They appreciated it, and there was no grumbling.

As I have gazed down upon the lifeless bodies of some of the noble men whom it has been my lot to see crash to the earth from lofty heights to meet death instantaneously, my heart has gleaned the full

meaning of patriotism, of right over might, and of the justice of a cause for which the best young blood of our land has been shed.

Those lifeless features but a moment ago were set in grim defiance, those limp hands were clutching the wheel in steady control, and with nerves alert when the unexpected came. Did the flyer try to meet it? Yes! to the very last precious inch of space allowed him he worked in frantic, grim desperation. Down swift as a shot he goes; the inevitable stares at him. He does not shut his eyes and wait. No! he clamps his teeth and works to the very last moment, and then it is over in a fraction of a second. All great fliers expect this kind of death some day, and one who knows them can never doubt the earnestness of that last grim effort before the fatal crash.





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